Yang Peng, Falko Pientka, Leonid I. Glazman, Felix von Oppen

Strong localization of Majorana end states in chains of magnetic adatoms

arXiv:1412.0151

A recent experiment [Nadj-Perge et al., Science 346, 602 (2014)] gives possible evidence for Majorana bound states in chains of magnetic adatoms placed on a superconductor. While many features of the observed end states are naturally interpreted in terms of Majoranas, their strong localization remained puzzling. We consider a linear chain of Anderson impurities on a superconductor as a minimal model and treat it largely analytically within mean-field theory. We explore the phase diagram, the subgap excitation spectrum, and the Majorana wavefunctions. Owing to a strong velocity renormalization, the latter are localized on a scale which is parametrically small compared to the coherence length of the host superconductor.

A.D. Rud, I.M. Kirian, A.M. Lakhnik

Topological characteristics of local atomic arrangements at crystalline-amorphous structural transition in graphite

arXiv:1412.1982

Quasi-continuous structural transformation from the crystalline to amorphous state takes place in graphite during ball-milling. The quantitative characteristics of a short- and a medium-range orders in carbon nanomaterials structure are determined by a combined application of X-ray diffraction analysis, reverse Monte Carlo modeling and Voronoi diagram method. High resolution TEM images revealed formation of globular carbon materials having onion-like structure. The Voronoi polyhedra (VP) constructed for simulated atomic configurations of the ball-milled graphite have an extraordinary variety in their topological and metric characteristics and contain a lot of 5-fold faces. The analysis of VP sphericity coefficient Ksph enables a conclusion about the change of the local atomic arrangement in a structure of ball-milled carbon from graphite- to diamond-like. The sphericity coefficient is proposed to be as a parameter of the topological order to quantitative estimation of disordering degree in amorphous structures.

M.M. Glazov, A.V. Kavokin

Spin waves in semiconductor microcavities

arXiv:1412.1758

We show theoretically that a weakly interacting gas of spin-polarized exciton-polaritons in a semiconductor microcavity supports propagation of spin waves. The spin waves are characterised by a parabolic dispersion at small wavevectors which is governed by the polariton-polariton interaction constant. Due to spin-anisotropy of polariton-polariton interactions the dispersion of spin waves depends on the orientation of the total polariton spin. For the same reason, the frequency of homogeneous spin precession/polariton spin resonance depends on their polarization degree.

A. L. Chudnovskiy, V. Kagalovsky

Thermal and electrical quantum Hall effects in ferromagnet-topological insulator-ferromagnet junction

arXiv:1412.1697

The ferromagnet-topological insulator-ferromagnet (FM-TI-FM) junction exhibits thermal and electrical quantum Hall effects. The generated Hall voltage and transverse temperature

gradient can be controlled by the directions of magnetizations in the FM leads, which inspires the use of FM-TI-FM junctions as electrical and as heat switches in spintronic devices. We present the theoretical description for a class of experimental setups that measure quantum Hall coefficients. Thermal and electrical Hall resistances are calculated as functions of the magnetization directions in ferromagnets, the spin-scattering time in TI, and positions of FM leads and measurement contacts. Both the Hall voltage and the transverse temperature gradient decrease but are not completely suppressed even at short spin-scattering times. The Hall coefficients turn out to be independent of the spin-scattering time for symmetric configuration of FM leads and measuring contacts.

Tuukka Hiltunen, Hendrik Bluhm, Sebastian Mehl, Ari Harju

Charge-noise tolerant exchange gates of singlet-triplet qubits in asymmetric double quantumdots

arXiv:1412.1667

In the semi-conductor double quantum dot singlet-triplet qubit architecture, the decoherence caused by the qubit's charge environment poses a serious obstacle in the way towards large scale quantum computing. The effects of the charge decoherence can be mitigated by operating the qubit in the so called sweet spot regions where it is insensitive to electrical noise. In this paper, we propose singlet-triplet qubits based on two quantum dots of different sizes. Such asymmetric double dot systems allow the implementation of exchange gates with controllable exchange splitting J operated in the doubly occupied charge region of the larger dot, where the qubit has high resilience to charge noise. In the larger dot, J can be quenched to a value smaller than the intra-dot tunneling using magnetic fields, while the smaller dot and its larger splitting can be used in the projective readout of the qubit.

I.I. Soloviev, N.V. Klenov, S.V. Bakurskiy, V.V. Bol'ginov, V.V. Ryazanov, M.Yu. Kupriyanov, A.A. Golubov

Josephson magnetic rotary valve

arXiv:1412.1643

We propose a control element for a Josephson spin valve. It is a complex Josephson device containing ferromagnetic (F) layer in the weak-link area consisting of two regions, representing 0 and π Josephson junctions, respectively. The valve's state is defined by mutual orientations of the F-layer magnetization vector and normal to the interface separating 0 and π sections of the device. We consider possible implementation of the control element by introduction of a thin normal metal layer in a part of the device area. By means of theoretical simulations we study properties of the valve's structure as well as its operation, revealing such advantages as simplicity of control, high characteristic frequency and good legibility of the basic states.

E. Strambini, F. S. Bergeret, F. Giazotto

Mesoscopic Josephson junctions with switchable current-phase relation

arXiv:1412.0998

We propose and analyze a mesoscopic Josephson junction consisting of two ferromagnetic insulator-superconductors (FI-Ss) coupled through a normal metal (N) layer. The Josephson current of the junction is non-trivially affected by the spin-splitting field induced by the FIs in the two superconductors. In particular, it shows sizeable enhancement by increasing the amplitude of the exchange field (hex) and displays a switchable current-phase relation which depends on the relative orientation of hex in the FIs. In a realistic EuS/Al-based setup this junction can be exploited as a high-resolution threshold sensor for the magnetic field as well as an on-demand tunable kinetic inductor.